READ THIS IMPORTANT INFORMATION

RAYTHEON

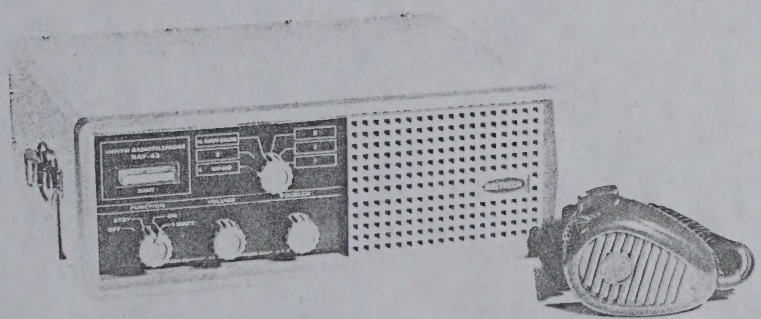
MODEL

RAY-43 VHF

Marine

RADIOTELEPHONE

Operation and Maintenance Manual



RAYTHEON COMPANY
Marine Products Operation
South San Francisco, Calif

Errata

The following Engineering change was incorporated in this Radiotelephone after the manual was printed.

1. Capacitor C43 added in parallel with C6.

2. Correct the Replacement Parts List as follows:

C43	0235-7215P043	Cap., 2000uf., 20 volt. elec.

Additional log books may be obtained from your dealer.

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I DESCRIPTION

1.1 General

This VHF Marine Radiotelephone is designed for the "do-it-yourself" installer when used with the Webster M-51 VHF Marine Antenna. The radio operates from a 12 volt DC (nominal) power source and provides reliable two-way radio communications in the 156.300-162.55 MHz band. Accessory units are available to utilize 24 and 32 volt DC and 115 volt AC 50/60 Hz power sources. Six crystal controlled transmitting and receiving channels are provided. The receiver features a squelch (noise muting) circuit with front panel control. Latest design techniques and highest quality components are used. All operating controls are located on the front panel for easy accessibility. One control selects both the transmitter and receiver frequencies for the desired operating channel. The microphone push-to-talk switch activates the transmitter circuity and mutes the receiver automatically.

The radio is entirely self-contained (power supply for 12 volt operation included). The small size of the radio permits mounting in most any convenient location such as on a shelf, bulkhead or the overhead.

There is a 5-foot pendant lead (color coded red) extending from the rear panel which connects to the positive (+) 12 volt DC power source; the 5-foot black lead connects between the GROUND post and the negative (-) 12-volt DC power source. Also on the back panel are located the following terminals: Auxiliary power supply control (dry-circuit pair), External speaker (pair), Keying control for accessory RF Linear amplifier and a type SO-239 coaxial connector for the antenna lead in. The protective fuse is located in a holder in the red (positive +) pendant lead.

1.2 Equipment Furnished

Radiotelephone w/microphone
Mounting Yoke
Instruction Manual

1.3 Accessories Available

24/32 volt DC adapter
115 volt AC adapter
Remote Speaker 3.2 ohm. V.C.

1.4 Specifications

1.4.1 Transmitter

Channels:	Six-with crystals for channels 06 and 16 furnished
Frequency Range:	156.300 to 157.425 mHz
Frequency Stability:	± 10 ppm (.001%) - 30° to +60°C
Power Output:	2.9 watts into 52 ohm load reducible to 1 watt
Modulation:	Phase modulated 16F3 (± 5KHz deviation for 100% modulation)
Modulation Limiting:	Instantaneous, automatic at 100% modulation
Audio Response:	6db pre-emphasis 300-3000 Hz +1-3db
Audio Roll-off Filter:	Exceed FCC requirements of 18db per octave beyond 3000 Hz
Spurious & Harmonic Outputs:	At least 50db below rated outputs
Hum & Noise Level:	At least 35db below full modulation

1.4.2 Receiver

Channels:	Six-with crystals for channels 06 and 16 furnished
Frequency Range:	156.300 to 157.025 and 161.600 to 162.550 mHz
Frequency Stability:	± 15 ppm (.001%) -30° to +60°C
IF Frequency:	16.9 mHz 1st IF & 455 kHz 2nd IF
Crystal Type:	CR77/U
Sensitivity:	1 uv (terminated for 20db quieting
Modulation Acceptance:	± 5Hz
Receiver Stability:	Less than 20 ppm, -30°C to +60°C (without functional failure at nominal line voltage, between 11.7 and 15.9 volts DC input)
Squelch Sensitivity	Not more than .75uv
Audio Output:	2.5 watts or more at 10% or less distortion into 3.12 oh load
Adjacent Channel Selectivity And Desensitization (EIA)	At least 50db
Spurious responses (typical)	Greater than 50db

1.4.3 Power Requirements:

Input Voltage:	13.8 volts DC (nominal)
Operating Range:	11.7 to 15.9 volts DC steady state operating band (nomina ± 15%)
Nominal Performance:	Unless otherwise specified, operating limits and specifi cations are at 13.8VDC

1.4.4 Input Current

Receive Mode (No Signal-Squelched)	.12 amps
Receive Mode (No Signal-Unsquelched)	.9 amps
Transmit (Standby-No Signal Squelched)	.6 amps
Transmit (Standby-No Signal Unsquelched)	1.4 amps
Transmit	4.5 amps

1.4.5 Dimensions:

Height	3-7/8 inches
Width	11 inches
Depth	9-1/4 inches
Weight	7-1/2 lbs.

II THE MARINE RADIOTELEPHONE SERVICE

The radiotelephone communications system is designed to serve these primary functions. In order of priority they are:

1. Safety: The International Calling and Safety Frequency, 156.80 MHz, is the keystone of the radiotelephone system. To insure that a maximum number of stations monitor this frequency, the International Regulations authorize its use for calls and replies.

2. Operational: Concerned with the exchange of information pertaining to navigation, movement and operation of vessels.

3. Business: Concerned with the handling of general communications between vessels, and with points on land via commercial shore stations providing extended telephone usage.

As a part of the marine safety and communication system, you have help at your fingertips wherever you may be.

When a grave and imminent danger threatens and immediate help is required, use the international distress signal MAYDAY (repeated three times) followed by the name of your vessel. Announced on 156.80 MHz, it will be heard by nearby boats as well as Coast Guard and commercial shore stations within range. Announced on a working channel of the shore stations in the area, it will permit direct connection to the proper agency on land. Upon acknowledgment, state your boat's name, your location, nature of trouble and assistance required.

For less serious situations than those warranting a MAYDAY call, you can talk with a nearby boat over a ship-to-shore frequency; or with any agency on land via a working frequency of a commercial shore station. Indicate that you are in trouble and your call will be given precedence.

While your set is turned on, keep the receiver adjusted for standby on 156.80 MHz so that you will be in a position to help others; they are doing the same for you. This watch may be interrupted when you are communicating with another boat or with a shore station.

When you hear an emergency call from another vessel, it is your obligation to terminate any communication which would interfere with the emergency communication, and to render any assistance possible.

Always give precedence to distress or other urgent calls. Limit your conversation to essentials - others are waiting.

Marine radio frequencies are few in number in comparison with the number of vessels equipped with radiotelephones. When you use one of these frequencies, you are using a gigantic party line. Cooperation is necessary so that all may have equal opportunity to make and receive calls.

The VHF-FM band, from 156.275 to 162.55 includes 39 channels, for use in the United States, its coastal waters, and the weather bureau station. See Table 2-1 for allocations of available VHF channels. Other channels will be allocated as necessary.

The weather bureau has VHF-FM radio transmitting facilities on 162.55 MHz. Crystals are available to adapt your receiver to this frequency. Additional stations are being put into service by the weather bureau. Contact your local office for additional up-to-date information.

RULES TO REMEMBER

Your Radio Can Mean Your Safe Arrival - Use It With Respect.

The following are some important points of proper usage recommended by the Radio Technical Commission for Marine Services, Washington D.C.

Be Sure to Give Name and Position of Vessel

Emergency Situations

Distress	Mayday - Mayday - Mayday
Urgency message concerning safety of vessel or person(s).	Pan - Pan - Pan
Safety of navigation or important weather information.	Security - Security - Security
1. Maintain Your Watch	Listen to 156.8 MHz when not in communication with another vessel (83.223).
2. Listen Before You Talk	Avoid interference with calls in progress (83.181).
3. Identify Your Vessel	Give your call sign and vessel's name at beginning and end of each communication (83.364).
4. Make Calls Correctly	Call other vessels on 156.8 MHz, then switch to intership channel (83.366). Call public shore stations, in general, on an appropriate working channel (83.366).
5. Use Channels Properly	156.8 MHz for emergencies and brief calls and replies (83.353) Intership for safety, operational or business communications (83.358).
6. Watch Your Language	Use of profane or obscene language is a criminal offense.
7. Be Brief At All Times	Limit calls to 30 seconds; Conversations to 3 minutes (83.366)
8. Keep An Accurate Log	Make entries as required by 83.366.
9. Have Documents Handy	Ship Station License; Operator License or permit; Part 83 of FCC Rules; Log Book (83.367).

Channel Designator	Frequency		Points of Communications	Authorized Communications
	Ship	Coast		
65	156.275	156.275	Ship-ship/ship-Coast	Port Operations
06	156.300		ship-ship	Intership Safety
66	156.325	156.325	Ship-ship/ship-Coast	Port Operations
07	156.350	156.350	Ship-ship/ship-Coast	Commercial
67	156.375		Ship-ship	Commercial
08	156.400		Ship-ship	Commercial
68	156.425	156.425	Ship-ship/ship-Coast	Non-Commercial
09	156.450	156.450	Ship-Coast	
69	156.475	156.475	Ship-Coast	Non-Commercial
10	156.500	156.500	Ship-ship/ship-Coast	Commercial
70	156.525		Ship-ship	Non-Commercial
11	156.550	156.550	Ship-ship/ship-Coast	Commercial
71	156.575	156.575	Ship-Coast	Non-Commercial
12	156.600	156.600	Ship-ship/ship-Coast	Port Operations
72	156.625		Ship-ship	Non-Commercial
13	156.650	156.650	Ship-ship/ship-Coast	Navigational
73	156.675	156.675	Ship-ship/ship-Coast	Port Operations
14	156.700	156.700	Ship-ship/ship-Coast	Port Operations
74	156.725	156.725	Ship-ship/ship-Coast	Port Operations
15		156.750	Coast-ship	Environmental
16	156.800	156.800	Ship-ship/ship-Coast	Distress, Safety & Calling
17	156.850	156.850	Ship-ship/ship-Coast	State Control
77	156.875		Ship-ship	Commercial
18	156.900	156.900	Ship-ship/ship-Coast	Commercial
78	156.925	156.925	Ship-Coast	Non-Commercial
19	156.950	156.950	Ship=ship/ship-Coast	Commercial
79	156.975	156.975	Ship-ship/ship-Coast	Commercial
20	157.000	161.600	Ship-ship/ship-Coast	Port Operations
80	157.025	157.025	Ship-ship/ship-Coast	Commercial
24	157.200	161.800	Ship-Public Coast	Public Corres.
84	157.225	161.825	Ship-Public Coast	Public Corres.
25	157.250	161.850	Ship-Public Coast	Public Corres.
85	157.275	161.875	Ship-Public Coast	Public Corres.
26	157.300	161.900	Ship-Public Coast	Public Corres.
86	157.325	161.925	Ship-Public Coast	Public Corres.
27	157.350	161.950	Ship-Public Coast	Public Corres.
87	157.375	161.975	Ship-Public Coast	Public Corres.
28	157.400	162.000	Ship-Public Coast	Public Corres.
88	157.425		Ship-ship	Commercial

TABLE 2-1, VHF CHANNEL DESIGNATORS

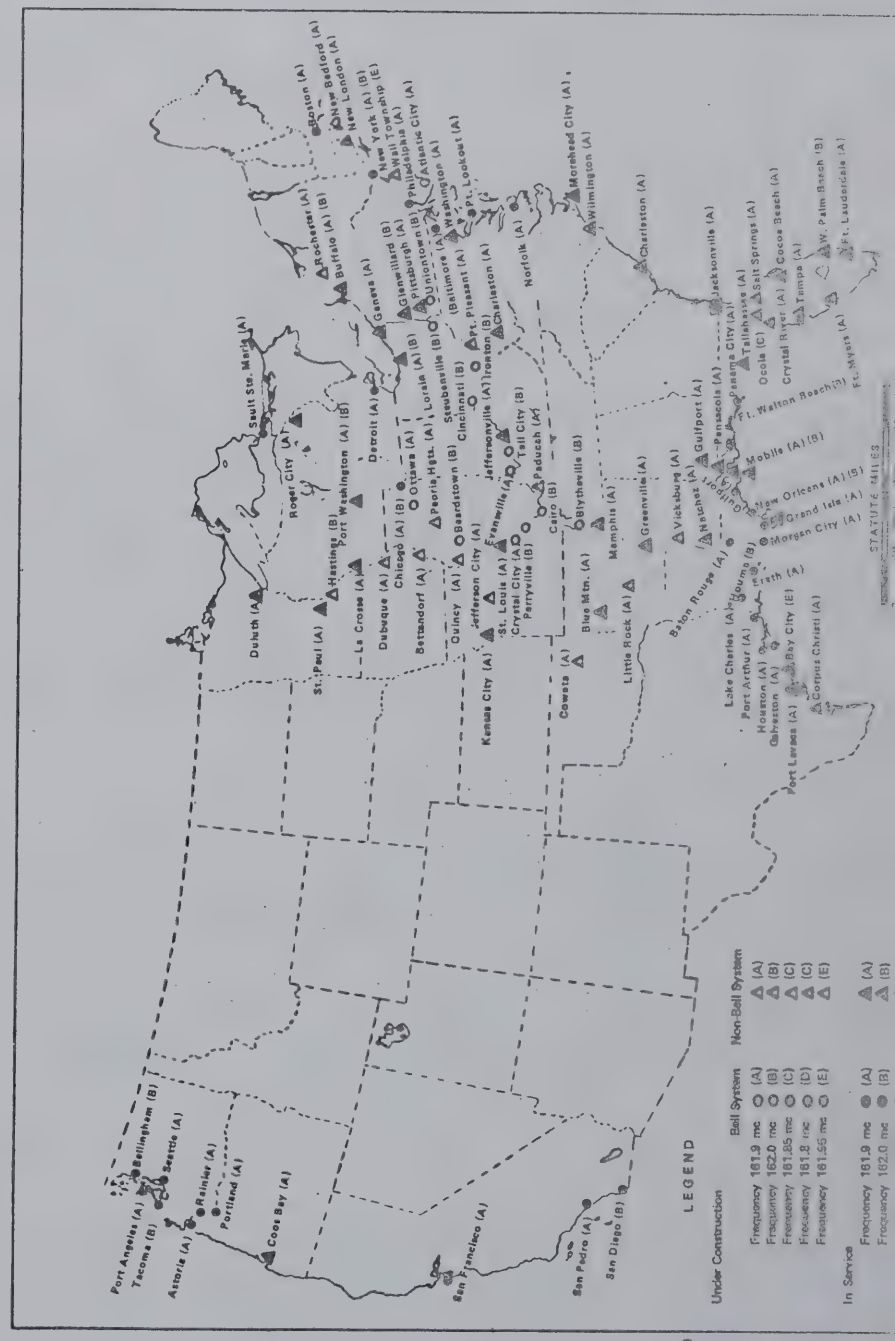


Fig. 2-1 Chart of US VHF Stations

III LICENSING

3.1 Station License:

A Ship License may be obtained by one of two methods (1) By sending a properly executed application (FCC Form 502) directly to the Secretary, Federal Communications Commission, Washington, D.C. 20554. This may result in a waiting period of several days; therefore, an alternate and faster method is to (2) present the application to your nearest FCC Field Office, in person, and request an Interim Ship Station License. The interim license, which is valid for six (6) months, will be granted immediately provided the formal application is properly executed. Your dealer or serviceman will be glad to assist you in completing the application form. Technical information has been filed with the FCC by the factory, so it is only necessary to refer to the model number and maximum plate input power on the application. Operate your radio only when you have a valid station license; and keep the license posted on board your boat.

3.2 Operator's License:

An Operator's License may be obtained by applying to the local office of the FCC for a Restricted Radiotelephone Operator's Permit. Use FCC Forms 753A. Operate your radio only when you have a valid permit, or someone else on board has one.

3.3 FCC Rules, Part 83:

Observance of Part 83 of the Commission's Rules is necessary for the radio-telephone communications system to provide its full advantages.

3.4 FCC Field Offices:

Mailing addresses for Commission Field Offices are listed below. Street addresses can be found in local directories under "United States Government". Address all communications to Engineer in charge.

Alabama 36602, Mobile	Louisiana 70130, New Orleans
Alaska 99501 P.O. Box 644, Anchorage	Maryland 21201, Room 819 Federal Building, Baltimore
California 90014, Los Angeles	Massachusetts 02109, Boston
California 92101, San Diego	Michigan 48226, Detroit

California 94126, San Francisco

California 90731, San Pedro

Colorado 80202, Denver

District of Columbia 20554, Washington

Florida 33101 P.O. Box 150 Miami

Florida 33606, Tampa

Georgia 30303, Atlanta

Georgia 31402, P.O. Box 77, Savannah

Hawaii 96808, Honolulu

Illinois 60604, Chicago

Minnesota 55102, St. Paul

Missouri 64106, Kansas City

New York 14203, Buffalo

New York 10014, New York

Oregon 97205, Portland

Pennsylvania 19106, Philadelphia

Puerto Rico 00903, San Juan

Texas 77704, P.O. Box 1527, Beaumont

Texas 75202, Dallas

Texas 77002, Houston

Virginia 23510, Norfolk

Washington 98104, Seattle

3.5 Station Log:

The law states that a station log shall be maintained during the hours of service of ship stations using radiotelephone. The first entry in the log should be the installing technician's statement to the effect that the transmitter frequency and modulation have been checked.

IV OPERATION

4.1 CONTROLS - FUNCTION

4.1.1 Channel Selector: Selects transmitting and receiving channel simultaneously; also will select the weather station channel provided the radio is equipped with the appropriate crystal.

4.1.2 Squelch: Mutes backgound noise during the time when no signals are being received.

4.1.3 OFF/STANDBY/ON/1 WATT: Applies power to the radio. OFF position removes all power; STANDBY position supplies power to the receiver only; ON position furnishes power to the transmitter and receiver. 1 WATT position reduces the transmitter power output to 1 WATT on all channels.

4.1.4 Volume: Adjusts the receiver volume to the desired level.

4.2 OPERATING PROCEDURE

4.2.1 General: The following procedures apply when calling or receiving with this radio.

4.2.2 To Receive:

4.2.2.1 Rotate the OFF/STANDBY/ON/1 WATT switch to the STANDBY position if transmitting and receiving are anticipated. Turning the control to the 1 WATT position reduces the transmitter output power to 1 WATT on the channel selected.

4.2.2.2 Adjust the VOLUME control to a comfortable listening level.

4.2.2.3 Set the channel selector to the desired operating channel and readjust the volume control as necessary.

4.2.2.4 Adjust the SQUELCH control clockwise slowly until the background noise is just muted. This should be done at the time when there are no signals being received. It is important that this control be adjusted just to the threshold point otherwise a weak signal will not open the squelch. When a transmitter comes on the air, it will trip the squelch circuit, allowing the signal to be heard.

4.2.3 To Transmit:

4.2.3.1 Turn the OFF/STANDBY/ON/1 WATT switch to ON, wait approximately 45 seconds for the tube filaments to reach operating temperature.

4.2.3.2 Select the desired channel and listen carefully to make sure it is not busy. If it is busy you will hear voices or an intermittent busy tone. Do not interrupt unless an emergency situation exists.

4.2.3.3 If the channel is not busy, press the push-to-talk button on the microphone to place your transmitter on the air. Announce the name of the boat you are calling and the call letters (if available) followed by the name of your boat and your call letters. Repeat if necessary. Release the microphone button to receive a reply. At the end of the conversation announce that you are signing off and again give the name and call sign of your boat.

Your transmitter is on the air when the microphone button is depressed. Only then can others hear you. The receiver operates only when the button is released. Only then can you hear others.

PUSH TO TALK

RELEASE TO LISTEN

When the conversation is to take place on a ship-to-ship frequency (unless prior arrangements have been made), make your initial contact on 156.8 MHz (CH16) and then shift to the agreed upon frequency.

When the conversation is to take place through a commercial shore station, make your initial contact on a working frequency of that station. This will speed your call.

Both of the above practices are designed to relieve the load on 156.8 MHz so that its utility for safety purposes will not be jeopardized.

V INSTALLATION

5.1 Mounting the Radio

A little care in planning the installation of a marine radiotel phone can contribute much toward insuring that maximum performance, utility and trouble-free operation is obtained from the equipment. In planning the installation, consideration should be give to the following:

5.1.1 The location of the unit should be chosen to provide eas access to the microphone and controls and to provide max imum protection from salt spray or splashing water. A horizontal shelf is the most compatible type of mounting for the bracket furnished with the radio.

5.1.2 Consideration should also be given to the routing of the power and antenna cabling.

The following illustration show some typical mounting locations

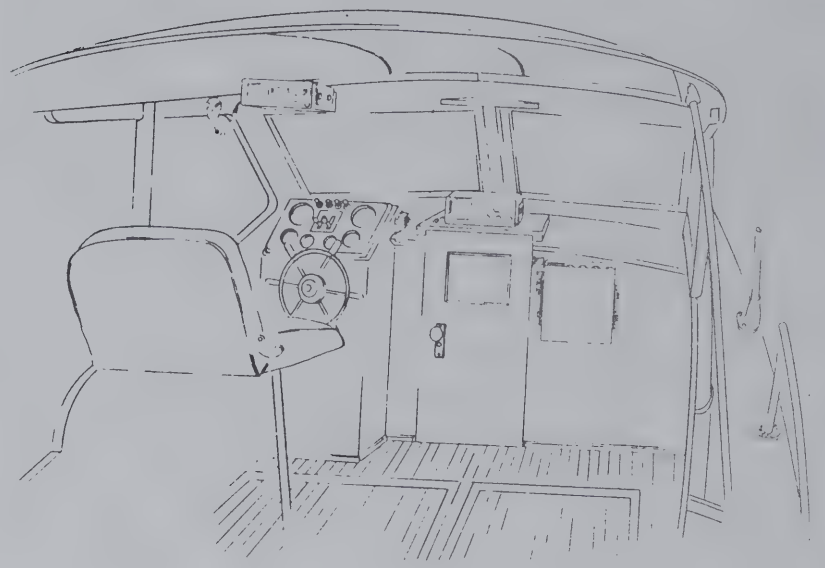


Fig. 5-1 Typical Installations

5.2 Electrical Connections (See Fig. 5-3)

Connect the RED and BLACK Pendant leads to a 12-volt DC power source; RED to positive (+) and BLACK to negative (-). If the leads must be extended to reach the source of power, wire of adequate size must be used. See table following:

#12 Stranded for runs of 10 feet or less.

#10 Stranded for runs of 10 to 20 feet.

#8 Stranded for runs of 20 to 30 feet.

NOTE

The extension leads must be color coded to preclude the possibility of inadvertently reversing the polarity of the input leads.

In most marine installations the negative (-) post of the battery is connected to the engine (inboard or outboard) as shown in Figure 5-3. If this connection does not exist it is extremely essential that a jumper of at least #10 stranded wire be connected between the engine and the negative (-) post of the battery. Be sure that the selected grounding point on the engine is cleaned to bare metal to insure the best possible ground.

IMPORTANT

Do not install this radio on a vessel with a positive ground battery system.

5.3 Antenna

The model M-51 antenna recommended for use with this radio is designed to mount on the deck or cabin top, however, mounting the antenna on the top of a mast or extension will measurably increase the transmitting and receiving range. Mounting instructions and hardware are furnished with the antenna. The M-51 antenna has a 15-foot length of RG-58 a/u coaxial cable attached; where the cable requirement will exceed this length it is recommended that RG-8/u cable be used. If the mounting surface selected (deck or cabin top) does not have sufficient strength to support the antenna during heavy weather it may be reinforced with a plywood backing plate.

A full line of optional antennas and lay-down mounts is available from your dealer for use with this radio. However, if an antenna,

other than the Webster M51 is used, an FCC licensed technician must be employed to tune the antenna for the lowest SWR and re-tune the radio to the new antenna.

5.4 Bonding of Metalwork

All unbonded metalwork in the vicinity of the antenna, such as hand rails, steering cables, permanent halyards, windshield frame or plumbing can affect the performance of the radio. It is good practice to bond these together and ground to the engine with a heavy conductor and suitable clamps. In some cases, this bonding will be essential.

5.5 Remote Speaker

A terminal board is provided on the rear panel for connecting a remote speaker to monitor the receiver at a remote location.

The remote speaker may be of any design, suited to the environment, with a 3 to 4 ohm voice coil.

Connect the speaker to the terminals marked EXT SPKR, polarity of the connecting leads need not be observed but be sure that neither lead is grounded.

5.6 Additional Channels

Installation of crystals, adjustments, tune-up and other requirements to activate additional channels must be performed by an FCC licensed technician.

5.7 High/Low Power

To conform with the latest FCC directives, this radio can be operated in either the high or low power mode on all channels depending on the position of the FUNCTION switch.

5.8 Accessories

Provisions for connecting the accessory 24/32 volt DC and the 115 AC power supplies, the RF Linear Amplifier and a Remote Speaker are available on the rear panel of the radio.

VI THEORY OF OPERATION

6.1 CIRCUIT DESCRIPTION

6.1.1 Transmitter

The transmitter circuitry is located in part on the Receiver Printed Circuit Board, the Exciter Module and the Main Chassis.

The transmitter crystals (Y121-Y126) are located on the Receiver Printed Circuit Board. When a particular channel is selected for use, the diode associated with the crystal (channel) chosen is biased on and the remaining five diodes are biased off. In this manner the selected crystal is connected to the oscillator circuit.

The oscillator circuit Q501 and associated components is located on the Exciter Module. The oscillator is a crystal controlled Pierce type circuit with the output coupled from the emitter of Q501 to the buffer-amplifier Q502.

The Phase Modulator circuit is located in the collector of the buffer-amplifier and is comprised of a tuned inductance L502, fixed capacitors C509, C512 and C513 and voltage variable capacitor CR501. The audio voltage from the microphone is fed into the Exciter Module on J506 and passed through a peak limiter circuit and a low pass audio filter and into the bias circuit of the voltage variable capacitor CR501. The audio swings the bias voltage thus varying the resonant frequency of the modulator tuned circuit at the audio rate. This variation in resonance causes a phase shift in the RF voltage from the buffer-amplifier thus producing phase modulation.

The output of the phase modulator is amplified by tripler Q503 and doubler Q504. The 6.50 MHz output of the oscillator has now been multiplied 6 times to 39.0 MHz at the output of Q504 which is also the output of the Exciter Module.

The Exciter Module output is coupled to the grid of vacuum tube V1A, a triode Doubler operating class "C". V1A feeds V1B a pentode Doubler operating class "C". This multiplies the signal frequency to 156 MHz. V1B serves as a driver for the class "C" power amplifier V2. The plate tank of the power amplifier is a conventional PI-network with permeability tuning. The RF energy is coupled from the PI-network to the Transmit/Receive contacts of the changeover relay K1 and then to the Bandpass Harmonic Filter.. The output of the Filter is connected to the antenna jack J1.

6.1.2 Receiver

The receiver is a conventional dual conversion super-heterodyne

circuit. The receiver circuitry is located on the Receiver Printed Circuit Board with external connections to the channel selector switch, squelch control, volume control, audio power amplifier and antenna connector.

The signal is fed to the receiver from the antenna connector (J1) by way of the Bandpass Harmonic Filter and the transmit/receive contacts of relay K1, to J101 on the Receiver Printed Circuit Board. The signal is amplified by the RF Amplifier Q101 and fed to the base of the First Mixer Q102. Selectivity is provided by a single tuned circuit in the base and a double tuned circuit in the collector of Q101. Since the receiver signals may occur in two bands, 156.275-157.425 MHz and 161.600 -162.550 MHz, the resonance of the three tuned circuits is shifted from one band to the other by switching C106, C112 and C115 in and out with diodes CR101, CR102 and CR103. The programing of the diode switches is accomplished on one half of the channel selector switch. This programing may be changed to suit the customers needs.

The injection frequency, for the first Mixer, Q102, is derived from an oscillator-tripler circuit. The crystal controlled oscillator Q114 is a Colpitts type operating in the region of 48 MHz. When the operator selects a channel the proper crystal is connected to the oscillator by means of a diode switching circuit. The output of the oscillator is raised to the injection frequency by the Tripler Q115.

The IF output of the first Mixer, Q102, (16.9MHz) is fed through the 16.9 MHz filter (IC) to the base of the second Mixer Q103. The injection frequency of 16.445 MHz is derived from a Pierce Crystal controlled oscillator Q116. The IF output of the second Mixer (455 kHz) is fed through the 455 kHz ceramic filter which provides operating selectivity for the receiver.

The output of the filter is amplified by four untuned IF amplifier/limiter stages Q104, Q105, Q106 and Q107. The 455 kHz signal is demodulated by the ratio detector circuit consisting of transformer T101 and detector diodes CR104 and CR105.

The demodulated audio signal from the detector is amplified by Q108. The output of Q108 is split with a portion of the signal going to the volume control R21 (located on the front panel) and the remaining portion passes through a two section RC high-pass filter where the speech components are removed. This leaves a signal composed of any residual demodulated noise. This noise is amplified by a Darlington configuration device Q109 and the output is rectified by a diode CR106 to produce a DC squelch control voltage.

The audio signal from the volume control is fed back to the audio amplifier Q110 on the Receiver Printed Circuit Board.

This stage serves as a pre-amplifier for a three stage Direct Coupled Audio Power Amplifier Q112, Q113 and Q3 with a single ended class "A" output stage to drive the speaker.

Squelch action is provided by transistor clamp Q111 whose base receives a portion of the squelch control voltage depending on the setting of the squelch control R20. Under no-signal conditions, where the squelch is correctly set to the threshold point, the transistor clamp Q111 conducts, thus providing cut-off bias for the three stage amplifier. When a signal is received the clamp transistor is cut off and the three stage amplifier is biased on, permitting audio to be heard from the speaker.

6.1.3 Power Supply

The power supply unit provides 9.1 volts DC (+ 5%), stabilized from zener diode CR4, for all circuits except the tube stages and the audio Class A output stage. Supply to the Class A stage and tube heaters is taken directly from the nominal 12 volt DC input to the power supply. A push-pull switching inverter consisting of transistors Q1, Q2 and transformer T1, provides AC to the rectifier CR1 developing approximately 360 volts for the transmitter. A half wave rectifier circuit CR2 and capacitor C2 provides approximately -12 volts DC bias for the transmitter unit.

VII TUNE-UP AND ALIGNMENT

7.1 INSTALLATION OF ADDITIONAL CHANNELS

This radio is normally supplied with crystals installed for operation on Channels 6 and 16; the Ship to Ship and the Safety & Calling frequencies respectively. The crystal for Channel 6 is installed in switch position "A" and the Channel 16 crystal is in switch position "C".

When ordering crystals for additional channels the following pertinent information must be furnished:

7.1.1 Model number of the radio.

7.1.2 Part number of crystal 394-7224 (pair).

7.1.3 Frequency or channel desired.

The receiving crystal for the ESSA-Weather Bureau (162.55 MHz) can be ordered by specifying the letter W for the channel desir

IMPORTANT

Use only the correct crystals, part number 394-7224, that have been designed for use in this radio. Other crystals may appear to function, but will not give dependable communications under all conditions, and will not maintain the carrier stability within legal limits.

Check the receiving frequency of each additional channel and select a convenient channel switch position from those that are unused according to the table below.

SWITCH POSITION	RECEIVING FREQUENCY
A	156.300 MHz (Channel 6-factory installed)
B	Any frequency between 156.300 & 157.425 MHz
C	156.800 MHz (Channel 16-factory installed)
D	Any frequency between 161.600 & 162.500 MHz

E	Any frequency between 161.600 & 162.500 MHz
F	Any frequency between 161.600 & 162.500 MHz

Any receiving frequency in the 161.600-162.550 MHz band can be transferred to the 156.275-157.425 MHz band by the following simple modifications. (Refer to Figures 7-1, 8-2 and 8-3).

Extend the jumper wire connecting terminals 1,2 and 3 of Function Switch S1 to the tap(s) associated with the frequency(s) being transferred to the lower band (See Fig. 7-1).

Remove the jumper connecting the trimmer capacitor and diode associated with the channel(s) being transferred; install a .68 uh choke (part no. 0375-7444P004) in place of the jumper.

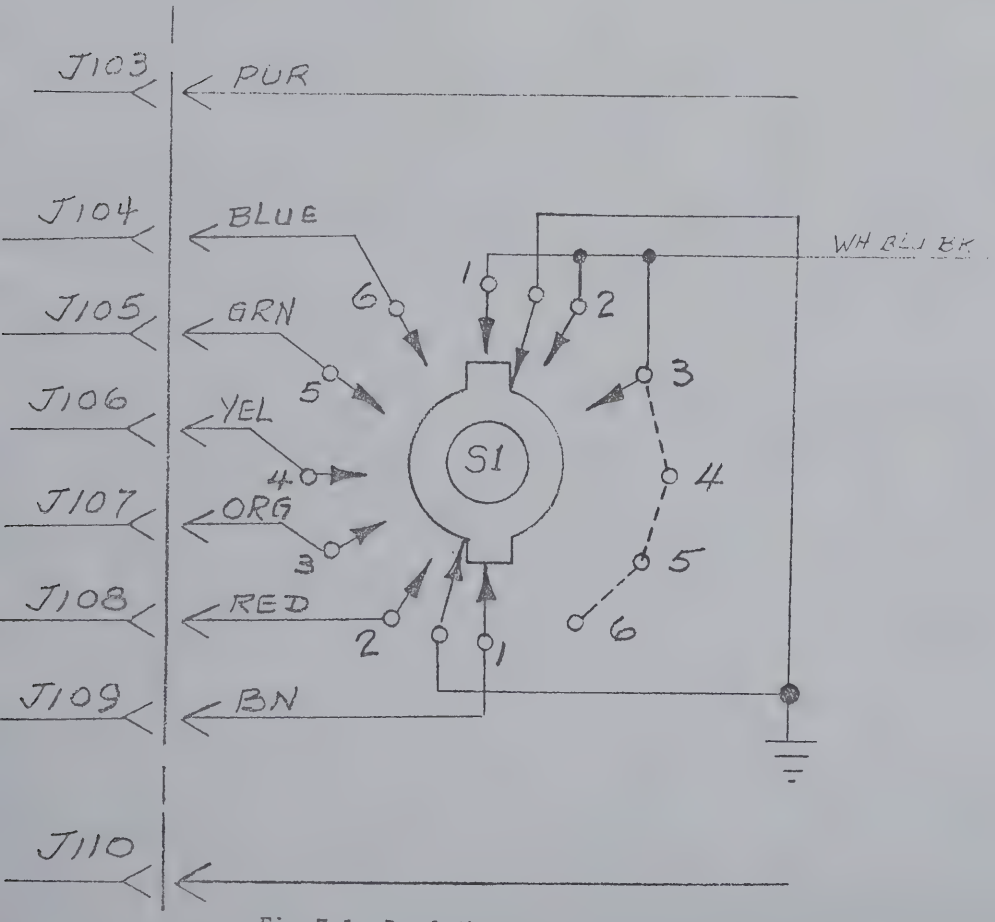


Fig 7-1 Band Changing Jumpers

7.2 POST INSTALLATION TUNE-UP

7.2.1 With M-51 Antenna

This radio is factory pretuned on channels 6 and 16 into a 50 ohm load; additional tuning will not be required when the recommended Webster M-51 antenna is installed.

7.2.2 With Antenna Other Than M-51

If an antenna other than the Webster M-51 is installed it must b adjusted for minimum VSWR before transmitter tuning is attempted

To tune the final amplifier connect an in-line wattmeter in the antenna feed line or use a field strength meter, and adjust L-7 for maximum output.

The frequency may be adjusted on each operational channel with the appropriate trimmer, C189-C194 located on the Receiver Printed Circuit Board.

7.3 ALIGNMENT AND ADJUSTMENT

7.3.1 General

Major repairs and/or component replacement may require readjustment of the exciter, transmitter or receiver. The procedure is as follows:

The following test equipment is required in order to perform a complete alignment of the exciter, transmitter and receiver.

7.3.1.1	DC Power Supply of 13.8 VDC at 5 amps	Harrison 6291A
7.3.1.2	Wattmeter	Bird, Model 43
7.3.1.3	Dummy Load, 50 ohm	Bird, Model 8130
7.3.1.4	Wattmeter Element	Bird, Model 5C
7.3.1.5	Frequency Counter	HP5245L
7.3.1.6	Counter Plug-in (Pre-scaler)	HP5258A
7.3.1.7	Deviation Meter	Measurements 140
7.3.1.8	Audio Wattmeter	GR1840A
7.3.1.9	Oscilloscope	Tektronix 581A With 81 head

7.3.1.10	FM Signal Generator	HP202H
7.3.1.11	VOM	AVO Model 8
7.3.1.12	Audio Generator	HP200CD
7.3.1.13	VTVM	Boonton 91C
7.3.1.14	Distortion Analyzer	HP334A
7.3.1.15	RF AC VTVM	Boonton 91C
7.3.1.16	Plug-in	Tektronix 82 (and x10 probe)
7.3.1.17	Audio Voltmeter	HP400CD
7.3.1.18	Tee-Attenuator	GR 874 GAL

7.3.2 Transmitter and Exciter

7.3.2.1 Connect the radio to a steady reliable 13.8 volt DC power source.

7.3.2.2 Connect a Tee-Attenuator (GR 874 GAL), Wattmeter and 50 ohm Dummy Load to the antenna socket J1.

7.3.2.3 Turn the Function Switch to STBY (standby).

7.3.2.4 Measure the 9.1 volt B+ line at J114 on the Receiver Printed Circuit Board; limits are 8.6 to 9.6 volts DC.

7.3.2.5 Set the Channel selector to Channel 16.

7.3.2.6 Rotate the Function Switch clockwise to the ON position.

7.3.2.7 Adjust the power source to 13.8 volts DC $\pm$ 0.05 volts.

7.3.2.8 Disconnect the output coaxial cable from the Exciter printed circuit board and connect a 470 ohm 1/2 watt resistor directly across the output terminals, J501 and J502.

7.3.2.9 Turn the Deviation Control R524 fully clockwise for maximum gain.

7.3.3 Modulation and Audio Filter

7.3.3.1 Connect the Audio Generator output (at 200 ohms impedance) between the modulator input terminal J506 and the adjacent ground terminal J501. Set the Generator to 1 kHz.

7.3.3.2 Connect the Audio Voltmeter between the "hot" end of varactor diode CR501 and ground. (Maintain the voltmeter input capacity to a minimum, use RG58A/U coaxial cable of 3 feet or less in length). Set the voltmeter to the 1 volt range. Disconnect input lea from J505.

7.3.3.3 Increase the audio input for an output level of 440 (-5db on db scale).

7.3.3.4 Swing the Audio Generator from 300Hz to 2.5kHz maint ing the generator output level constant. Check that output at the voltmeter at the above frequencies is between +0, -2db of output at 1kHz.

7.3.3.5 Swing the Generator frequency to 5kHz, maintaining i output level constant. The output at the audio volt meter should be 25db or more below the output at 1kH

7.3.3.6 Transfer the voltmeter to J506 to measure the input level; it should not exceed 53mV.

7.3.3.7 Disconnect the Audio Generator and Audio Voltmeter.

7.3.4 RF Alignment

7.3.4.1 Reconnect the input lead to J505.

7.3.4.2 Connect the Oscilloscope probe to monitor the excite module output at J502 and J501, across the 470 ohm resistor.

7.3.4.3 Peak all the Exciter tuned circuits for maximum outpu Observe on the Oscilloscope that the frequency is nea 40MHz, other subharmonics will be visible at a lower level but tune for maximum output of the 40MHz compo nent. If the Exciter is completely detuned it may be necessary to first connect the Oscilloscope probe to the Collector of frequency tripler Q503 and to peak T501 for maximum output at a frequency near 20MHz. The Exciter tuned circuits tend to tune broadly; the cores should be approximately centered between the limits where no further change is apparent.

7.3.4.4 Check the peak-to-peak 40MHz output on the Oscilloscc it should not be less than 12 volts.

7.3.4.5 A final touch-up of the phase modulator is necessary after the PA module has been tuned up. Disconnect th incoming microphone lead from the Exciter printed circuit board at J506 and connect the Audio Generator

between the input terminal and ground. With the transmitter keyed on Channel 16, and sufficient audio output from the Generator at 1kHz to produce deviation limiting, rock the core of L502 for peak deviation.

7.3.5 Power Amplifier Tuning

7.3.5.1 Commence the alignment on Channel 16.

7.3.5.2 Turn the top slug of T2 out until it is flush with the top of the coil form.

7.3.5.3 Tune L9 and L5 for maximum RF power output.

7.3.5.4 Tune the bottom slug first then the top slug of T2 for maximum power output.

7.3.5.5 Tune L7 for maximum power output.

7.3.5.6 Repeat steps 7.3.5.3 through 7.3.5.5 until no more interaction is noted.

7.3.5.7 The power output should now be 2.9 watts maximum with 13.8 volts DC primary power input.

7.3.5.8 If the power output is high or low, select a capacitor value for C32 that results in 2.9 watts maximum output. The selecting should be made from the following values 22, 24, 27, 30, 33, 36, 39, 43 and 47 pf.

7.3.5.9 Whenever the value of C32 is changed, L7 must be retuned for maximum output.

7.3.5.10 Check the power output on the other operational channels; it should not exceed 2.9 watts.

7.3.5.11 If the power drops off noticeably at one end of the band then a very slight readjustment of L7 may be required.

7.3.5.12 Set the function switch to the 1-watt position.

7.3.5.13 The power output must not exceed 1 watt on all operational channels.

7.3.5.14 Check the deviations as described in the following section.

7.3.5.15 During final installation, with the antenna connected, it may be necessary to repeak the output tuning, L7, for maximum power on channel 16.

7.3.6 Deviation Adjustment

This adjustment can be made only with the radio tuned up and operating into a 50-ohm dummy load or an antenna. An accurate Deviation Meter must be used to monitor the carrier deviation.

a. Connect the Audio Generator in place of the microphone between the modulator input terminal J506 and the adjacent ground terminal. Set the Generator output to 1kHz.

b. Key the transmitter on Channel 16.

c. With the Generator set at 2.5kHz increase the output until a deviation of 2.5kHz is reached.

d. Increase the Generator output an additional 16db.

e. Swing the Generator frequency from 1 to 4 kHz and no the deviation.

f. Adjust the deviation control R524 if necessary so th the deviation does not exceed 5kHz at any frequency.

g. Check that this deviation is not exceeded on any oth channel.

h. An alternative method, suitable as a check, is to utter a steady tone (AH-H-H-H) into the microphone a a distance of 1-2 inches and check that the deviatio does not exceed 5 kHz.

7.3.7 Transmitter Frequency Adjustment

If the transmitter is approximately on frequency, precis adjustment can be obtained with the appropriate trimmer (C189-C194) located on the Receiver PC Board.

7.4 Receiver Alignment

7.4.1 General

Refer to section 7.3 for a list of the test equipment required for the following tests and alignment.

7.4.2 Test Setup

7.4.2.1 Connect the radio to the DC power supply; set the voltage at the power supply to 13.8 volts D.C.

NOTE

The voltage at the radio will be somewhat lower due to the resistance of the fuse.

7.4.2.2 Check that crystals are installed in channels 6 and 16 and that a 16.445 mHz crystal is installed in the local oscillator.

7.4.3 Short Circuit Check

7.4.3.1 Rotate the Function Switch to STBY (standby).

7.4.3.2 Monitor the DC current from the power supply. With the Squelch control fully CCW, the current should be approximately 0.8 amps.

7.4.3.3 Check that the voltage at J114 is between 8.6 and 9.6 volts DC.

7.4.3.4 With the Volume Control fully CCW, adjust R172 for a bias voltage of 0.8 volts DC measured at J118.

7.4.4 Channel Switching Test

7.4.4.1 Set the Channel Selector Switch to position "A".

7.4.4.2 Measure for 0 volts at J109 with the VTVM.

7.4.4.3 Rotate the Channel Selector Switch to position "B". The voltage at J109 should rise to 8.5 volts, and the voltage at J108 should decrease to 0 volts.

7.4.4.4 The low voltage should follow in sequence from J109 to J104 as the Channel Selector Switch is rotated from "A" to "F".

7.4.5 RF Amplifier Band-Switching

7.4.5.1 Set the Channel Selector Switch to position "A".

7.4.5.2 With the VTVM, measure the anode voltage of CR101, CR102, and CR103. It should be 0.8 ± 0.2 volts.

7.4.5.3 The voltage on the cathodes of CR101, CR102, and CR103 should be 0.2 ± 0.2 volts.

7.4.5.4 Set the Channel Selector switch to position "F".

7.4.5.5 The voltage on the anodes of CR101, CR102, and CR103 should be 6.3 ± 0.5 volts.

7.4.5.6 The voltage on the cathodes of CR101, CR102, and CR1 should be 8.0 ± 0.5 volts

7.4.5.7 While monitoring CR101 anode, rotate the Channel Sel tor switch through all positions. The anode voltage should be low on switch positions A, B and C, and high on positions D, E and F.

7.4.6 Local Oscillator Alignment (139.335-145.650 mHz)

7.4.6.1 Adjust C111, C112, C115 and C116 for minimum capaci

NOTE

Failure to do this will result in erroneous readings of the local oscillator injection voltage.

7.4.6.2 Preset C183 - C188 as shown in Figure 7-2.

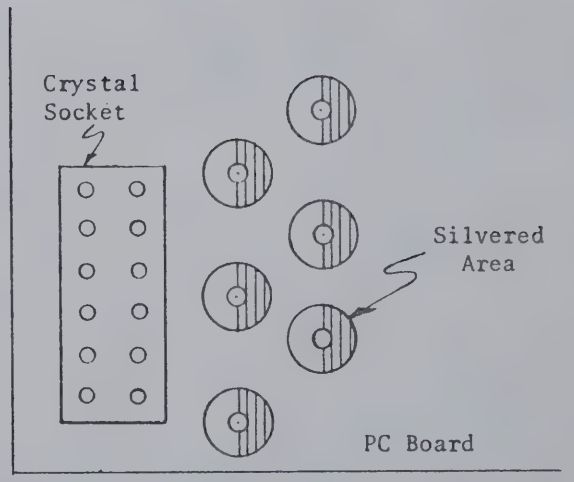


Fig. 7-2 PRELIMINARY SETTING OF RECEIVER TUNING CAPACITOR

7.4.6.3 Set the Channel Selector switch to position "A".

7.4.6.4 Connect the high impedance probe of the RF Voltmeter, through a 100K isolation resistor, to the junction of L112, R182, C199, C175, and C176.

7.4.6.5 Peak L109, L110, L111 and L112 for a maximum reading on the voltmeter.

NOTE

If the local oscillator strip is completely detuned, it may be necessary to hold the counter pick-up loop over Q115 and tune L109 and L110 to approximately 92 MHz before proceeding as above.

7.4.6.6 When L109, L110, L111 and L112 have been peaked on channel 6 (position "A"), note the reading on the RF Voltmeter. Adjust L109 CCW until the reading drops 1 db. Then adjust L110 CCW until the reading drops another 1db, then adjust L111 for another 1 db drop and L112 for an additional 1db drop.

7.4.6.7 With a search coil connected to the frequency counter, check the total oscillator frequency. Place the search coil near C199 for coupling. Set the local oscillator frequency to within ± 150 Hz on the four operating channels.

7.4.6.8 With the RF Voltmeter connected as in step 7.4.6.4 check the local oscillator injection voltage on the four operating channels. The voltage on switch positions "A" and "F" should be in the range of 13 to 18 mV and should be within 2 db of one another. The voltages for the intermediate channels will be somewhat higher.

NOTE

If the injection levels are not equal within 2 db for channels "A" and "F", then L109, L110, L111 and L112 should be adjusted equally to improve the balance. Turning the slug CCW favors channel "F", while turning the slug CW favors channel "A". The frequencies must be checked after each adjustment.

7.4.6.9 Use a channel 6 crystal to check that "B" channel local oscillator operates and can be tuned to frequency. A channel 26 crystal may be used to check channel "D".

7.4.7 R.F. Amplifier Alignment

7.4.7.1 Remove the 16.445 mHz local oscillator crystal.

7.4.7.2 Preset C105, C106, C111, C112, C115 and C116, if necessary, as follows. The pistons of C105, C111 and C116 should extend approximately 1/4 inch. The pistons of C106, C112, and C115 should extend approximately 1/2 inch.

7.4.7.3 Check that L101, L102, and L103 are approximately 7/16 inch long from end to end, and that L102 is 7/16 inch from L103. The coil form through L102 and L103 should be approximately 1/8 inch off the PCB.

7.4.7.4 Set the Channel Selector Switch to position "E".

7.4.7.5 Connect the RF Signal Generator to Antenna Terminal J-1. Set the signal generator to 161.9 MHz unmodulated.

7.4.7.6 Connect the RF Voltmeter through a 100K isolation resistor to Q102 collector and peak C105, C111 and C116 for a maximum reading.

7.4.7.7 Transfer the RF Voltmeter probe to Q103 collector. Peak C105, C111, C116, L104, L105, L106 and L107 for a maximum reading. Make the final adjustments with the generator output set to 1 mV. Note the voltmeter reading.

NOTE

It will help to align the 16.9 mHz IF transformers if the slugs were preset to within 1/16 inch of the top of the cans.

7.4.7.8 Set the Channel Selector switch to position "A".

7.4.7.9 Set the Signal Generator to 156.3 MHz.

7.4.7.10 With the RF Voltmeter connected to the collector of A103 and the generator output at 1 mV, peak C106, C112, and C115; note the voltmeter reading.

7.4.7.11 Set the Channel Selector switch to position "E".

7.4.7.12 Set the Signal Generator to 161.9 mHz at 1 mV output.

7.4.7.13 Check that the voltage on Q103 collector has not changed appreciably from that measured in step 7.4.7.7. If necessary, repeak C105, C111 and C116.

7.4.7.14 For 1 mV RF input, the voltage on the collector of Q103 should be in the range of 6 to 14 mV measured through a 100K isolation resistor.

.4.8 16.445 mHz Local Oscillator Adjustment

.4.8.1 Disconnect the Signal Generator from the radio.

.4.8.2 Insert the 16.445 mHz crystal into its socket.

.4.8.3 With a X10 scope probe connect the frequency counter to the collector of Q103. Adjust C178 for a frequency of 16.445 mHz ± 10 Hz.

.4.8.4 The local oscillator injection voltage, measured at Q103 emitter, through a 100K isolation resistor, should be between 2.5 and 4.5 mV.

4.9 Ratio Detector Alignment

4.9.1 Set the Channel Selector switch to position "E".

4.9.2 Disconnect the speaker. Connect the audio wattmeter, set for 3.2 ohms, to the external speaker terminals on the back of the radio.

4.9.3 Set the Squelch Control fully CCW.

4.9.4 Set the Volume Control for approximately 100 mW of noise output.

4.9.5 With no RF signal input, tune both cores of T101 for maximum noise output.

4.9.6 Connect the RF Signal Generator, set for 161.9 MHz at 20 microvolts, to the antenna input. Set the generator for ± 5 KHz deviation with a modulating frequency of 1 kHz.

.9.7 Connect an oscilloscope across the audio output.

.9.8 Slightly readjust the blue core of T101 for maximum audio output with the least visible distortion.

7.5 Receiver Performance Tests

7.5.1 Receiver Sensitivity Test - With the receiver tuned in accordance with section 7.4 the 20 db quieting sensitivity may be checked on all operational channels.

7.5.1.1 With no signal being fed into the receiver set the Volume Control for 100 mW of noise power.

7.5.1.2 Set the RF Signal Generator, on CW, to the frequency of the channel under test. Increase the level for 20 db quieting on the Audio Wattmeter.

7.5.1.3 Note the RF level into the receiver. This is the 20 db quieting sensitivity.

7.5.1.4 The 20 db quieting sensitivity should be less than 1.25 uV on all channels.

7.5.1.5 Modulate the carrier with 1000 Hz at ± 5KHz deviation.

7.5.1.6 The receiver should be capable of not less than 1 watt of audio power at the above sensitivity level.

7.5.2 Audio Output Test

7.5.2.1 Set the Channel Switch to "C" (Ch 16).

7.5.2.2 Set the Squelch Control fully CCW.

7.5.2.3 Set the RF Signal Generator to 156.8 mHz at a level of 10-20 uV modulated ± 5 KHz deviation with 1000 Hz.

7.5.2.4 Set the Volume Control for 1 watt of audio output power.

7.5.2.5 Connect the oscilloscope across the audio wattmeter and check that the audio output waveform is sinusoidal with less than 10% distortion.

7.5.2.6 Check that the maximum audio power output is not less than 2.5 watts.

7.5.3 Squelch Operation Check

7.5.3.1 Set the Channel Switch to "C" (Ch 16)

7.5.3.2 Set the Squelch Control fully CCW.

7.5.3.3 Set the RF Signal Generator to 156.8 MHz at a level of 10-20 uV modulated, ± 5 kHz deviation, with 1000 Hz.

7.5.3.4 Set the Volume Control for 1 watt of audio output power.

7.5.3.5 Remove the RF signal input.

7.5.3.6 Rotate the Squelch Control CW until the noise is squelched at least 30 db.

7.5.3.7 Reapply the RF signal input and increase the signal level until the squelch opens. This signal level input is the squelch sensitivity or squelch threshold.

7.5.3.8 The squelch sensitivity should be not more than .75 uV.

7.5.3.9 Rotate the Squelch Control fully CW.

7.5.3.10 Increase the signal level until the squelch opens.

7.5.3.11 Tight squelch should be not more than 3 uV.

7.5.3.12 Remove the Audio Wattmeter and reconnect the speaker.

7.5.3.13 Check speaker operation on the channel with the "W" crystal installed.

7.5.3.14 Remove the Channel 26 receiving and transmitting crystals and the "W" crystal.

VIII MAINTENANCE

8.1 General

This radiotelephone should provide years of reliable trouble-fre operation with a minimum amount of service. The radio is designed so that none of the components are working at or near their maximum rating. However, it is recommended that the radio and the antenna be checked periodically by a qualified technician. Periodic preventative maintenance will minimize the possibility of equipment failure at an inopportune time.

After each one thousand hours of operation the transmitter tubes should be thoroughly tested and replaced as found necessary.

The transfer relay is an open frame type with heavy duty contacts. These contacts are carefully adjusted during manufacture and cleaning should not normally be attempted.

Gradual decrease in transmitter performance is usually indicative of tube deterioration. If the tubes check normal and the output is below par check the antenna system. Pay particular attention to the cleanliness of the antenna insulator(s), condition of soldered connections, etc.

Occasionally a crystal will deteriorate with age, resulting in decreased output and low final grid current on the channel in which the crystal is used. Check by substituting a crystal of the same frequency and known activity. The chassis and cabinet are best cleaned with a vacuum cleaner or a clean dry cloth. Tubes can be cleaned with compressed air or a soft brush. Be sure to thoroughly clean tubes that operate at high temperature as a layer of dust will retard heat radiation and raise the operating temperature. Before closing the cabinet make sure that all tubes are reseated in their sockets and that socket clamps, tube clamps and tube shields are firmly in place. Periodically inspect tube pins; any dirt or corrosion found can usually be removed by working the tube up and down in the socket a few times.

Check fuse ferrules as they are subject to corrosion which increases circuit resistance. All fuses should therefore be removed from their holders and any accumulation of dirt and/or corrosion removed.

Plastic surfaces should be cleaned with lens tissue or a soft non-abrasive cloth. Care should be exercised when cleaning any plastic surface to prevent scratching. Mild soap and water may be used in stubborn cases. DO NOT USE SOLVENTS.

8.2 VACUUM TUBE AND TRANSISTOR COMPLEMENT

The following vacuum tubes and transistors are used in this radiotelephone.

8.2.1 Transmitter

8.2.1.1 Exciter Module

Q501	2N3564	Transistor	Oscillator
Q502	2N3564	Transistor	Buffer/Amplifier
Q503	2N3564	Transistor	Tripler
Q504	2N3564	Transistor	Doubler
Q505	2N3565	Transistor	Audio Amplifier
Q506	2N3565	Transistor	Audio Amplifier
CR501	1N3182	Varactor Diode	Modulator
CR502	RD5337	Diode	Deviation Limiter
CR503	RD5337	Diode	Deviation Limiter

8.2.1.2 RF Power Amplifier

V1A/V1B	8102	Triode/Pentode Vacuum Tube	Doubler/Doubler Driver
V2	8106	Pentode Vacuum Tube	Power Amplifier

8.2.1.3 Power Supply

Q1	Spec. 2N301	Transistor	Inverter
Q2	Spec. 2N301	Transistor	Inverter
CR1	1N2071	Diode	Bt Rectifier
CR2	1N2071	Diode	Bias Rectifier
CR3	1N2071	Diode	Reverse Polarity Protection
CR4	Zener 9.1V dc	Diode	9.1V dc Supply Regulator

8.2.2 Receiver

Q101	40242	Transistor	RF Amplifier
Q102	40242	Transistor	1st Mixer
Q103	40245	Transistor	2nd Mixer
Q104	40245	Transistor	455 kHz IF Amplifier
Q105	40245	Transistor	455 kHz IF Amplifier/Limiter
Q106	40245	Transistor	455 kHz IF Amplifier/Limiter
Q107	40245	Transistor	455 kHz IF Amplifier/Limiter
Q108	2N3565	Transistor	Audio Pre-Amplifier
Q109	D16P1	Transistor (Darlington)	Noise Amplifier
Q110	2N3565	Transistor	Audio Amplifier
Q111	TZ81	Transistor	Squelch Clamp
Q112	2N3565	Transistor	Audio Amplifier
Q113	2N3638	Transistor	Audio Amplifier
Q114	2N3564	Transistor	Local Oscillator
Q115	40242	Transistor	Multiplier
Q116	2N3564	Transistor	16.445 MHz Oscillator
Q3	2N3055	Transistor	Audio Power Amplifier
CR101	1N914	Diode	Bandpass Switching
CR102	1N914	Diode	Bandpass Switching
CR103	1N914	Diode	Bandpass Switching
CR104	1N914	Diode	Ratio Detector
CR105	1N914	Diode	Ratio Detector
CR106	1N295A	Diode	Noise Detector

CR107	1N914	Diode	Ch A Rec. Crystal Switch
CR108	1N914	Diode	Ch B Rec. Crystal Switch
CR109	1N914	Diode	Ch C Rec. Crystal Switch
CR110	1N914	Diode	Ch D Rec. Crystal Switch
CR111	1N914	Diode	Ch E Rec. Crystal Switch
CR112	1N914	Diode	Ch F Rec. Crystal Switch
CR113	1N914	Diode	Ch A Xmit Crystal Switch
CR114	1N914	Diode	Ch B Xmit Crystal Switch
CR115	1N914	Diode	Ch C Xmit Crystal Switch
CR116	1N914	Diode	Ch D Xmit Crystal Switch
CR117	1N914	Diode	Ch E Xmit Crystal Switch
CR118	1N914	Diode	Ch F Xmit Crystal Switch
CR119	1N295A	Diode	DC Feedback

8.3 FINAL POWER AMPLIFIER OPERATING PARAMETERS

8.3.1 General

The following measurements were made on a transmitter tuned and operating on Channel 16 with no modulation. The supply voltage was held at 13.80V DC. The below named equipment and procedures were used for the various measurements:

(a) Supply Voltage: Measured at the input terminals with Differential Voltmeter, Honeywell DC100B.

(b) Supply Current: "AVO" Meter Model 8 Mk III.

(c) Plate Voltage: Measured at junction of R9 with "AVO" Model 8 Mk III.

(d) Screen Voltage: "AVO" Model 8 Mk III.

(e) Screen Current: Calculated by measuring voltage drop across resistors in screen circuit with "AVO" Model 8 Mk III.

(f) Grid Voltage: Measured across R14 with VTVM Hewlett Packard Model 410B.

(g) Grid Current: Calculated by measuring voltage drop across R14 with VTVM Hewlett Packard Model 410B.

(h) Plate Current: Calculated by measuring drop across R19 with "AVO" Model 8 Mk III, correction applied for true value of R19.

(i) Power Output: Wattmeter Bird Model 43 with Element 5C.

(j) Dummy Load: 50 ohm Bird Model 80BNCM.

8.3.2 Typical PA Operating Voltages

Measure Points	Normal Mode	Low Power Mode
Plate		
Voltage	355V dc	365V dc
Current	29.62 ma.	11 ma.
Input	10.5 watts	4.02 watts
Screen Grid		
Voltage	152V dc	41.5V dc
Current	5.88 ma.	1.25 ma.
Input	893 watts	.052 watts
Control Grid		
Voltage	-14.5V dc	-15.8V dc
Current	3.25 ma.	3.63 ma.
Cathode		
Current	35.5 ma.	12.25 ma.
Power Output		
Power Output	2.9 watts	.6 watts
Equipment Input		
Voltage	13.8V dc	13.8V dc
Current	4.45 amps.	3.95 amps.
Load	61.5 watts	54.5 watts

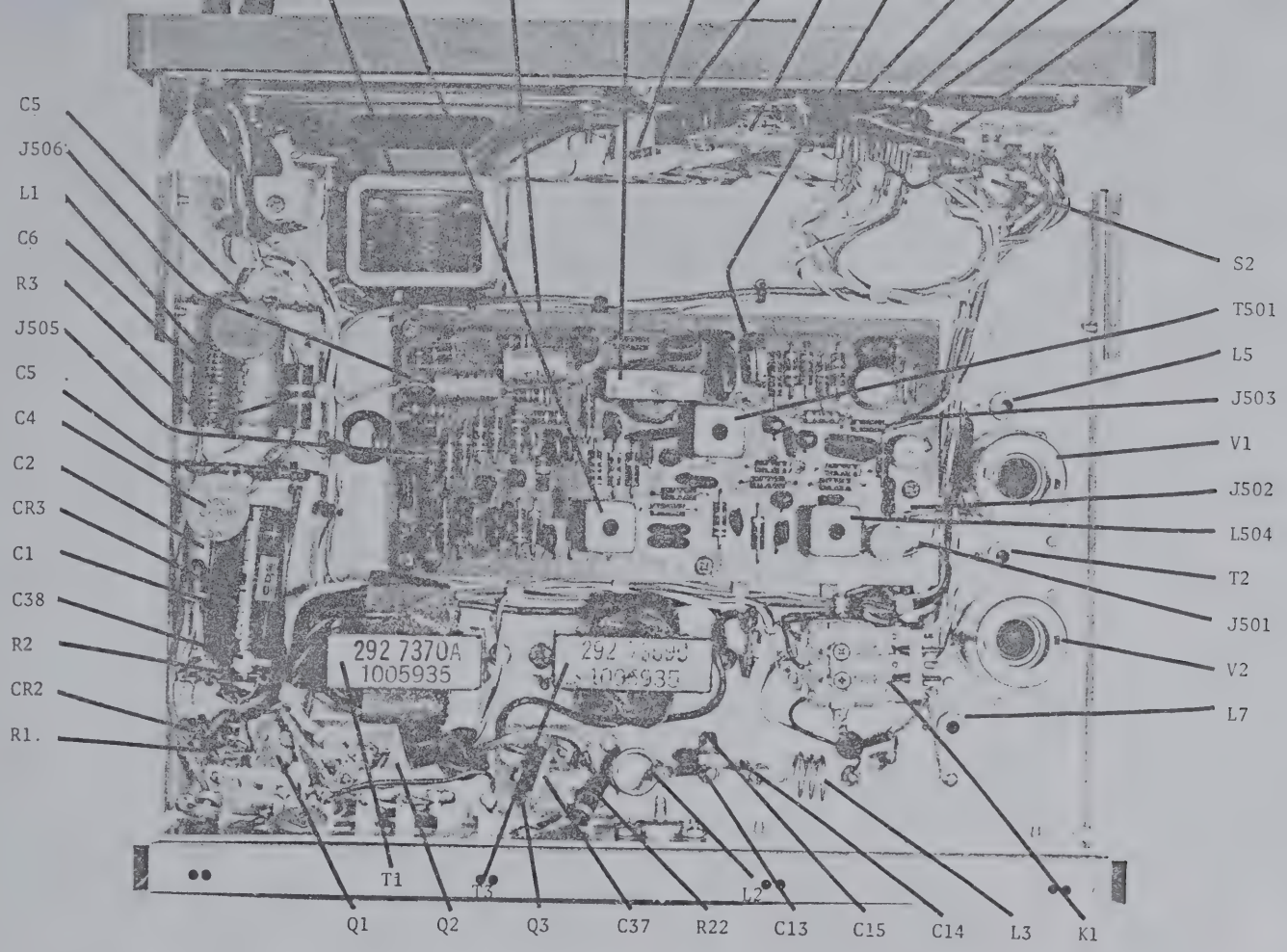


Fig 8-1 Chassis-Top View

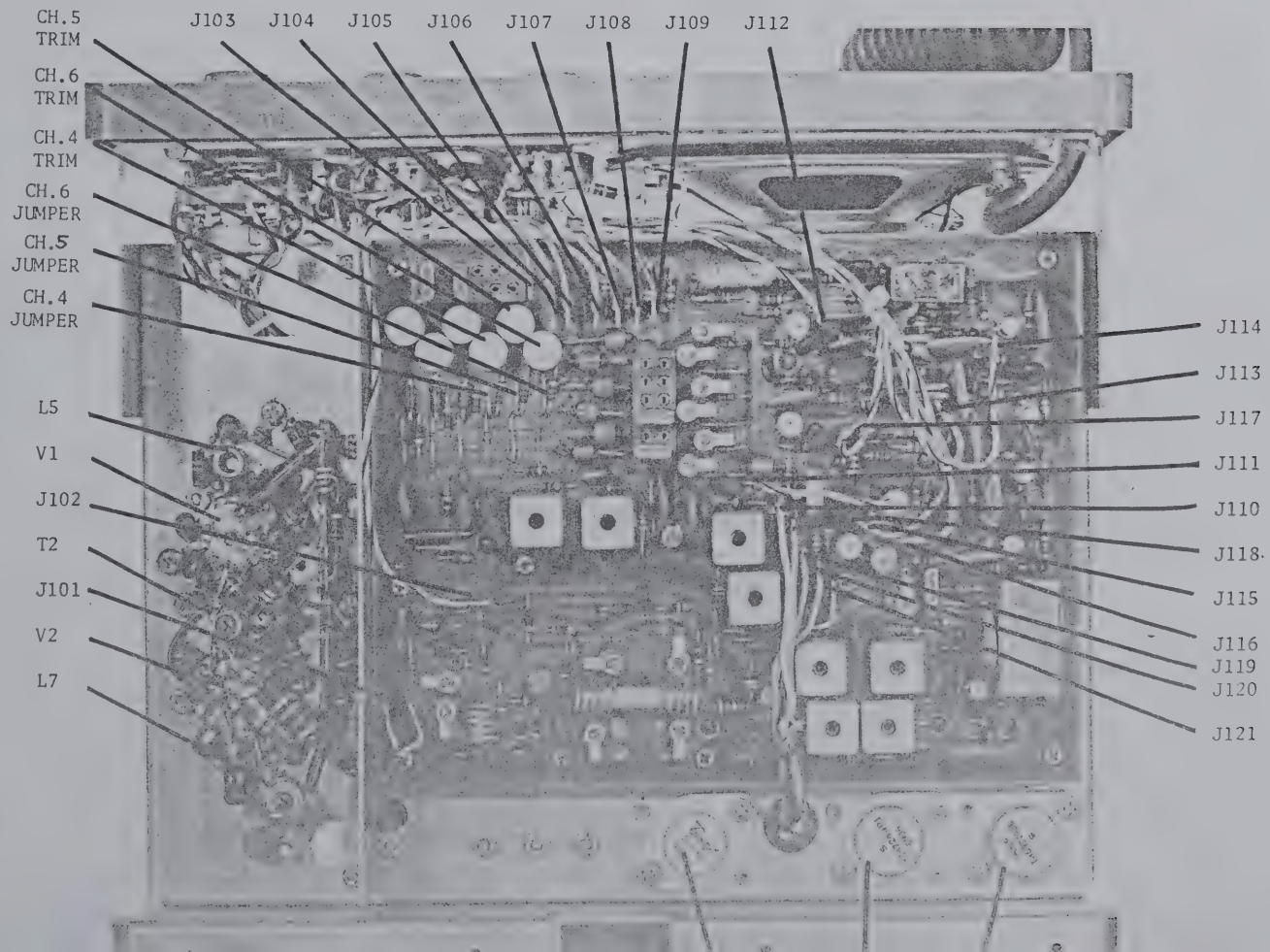


Fig 8-2 Chassis-Bottom View

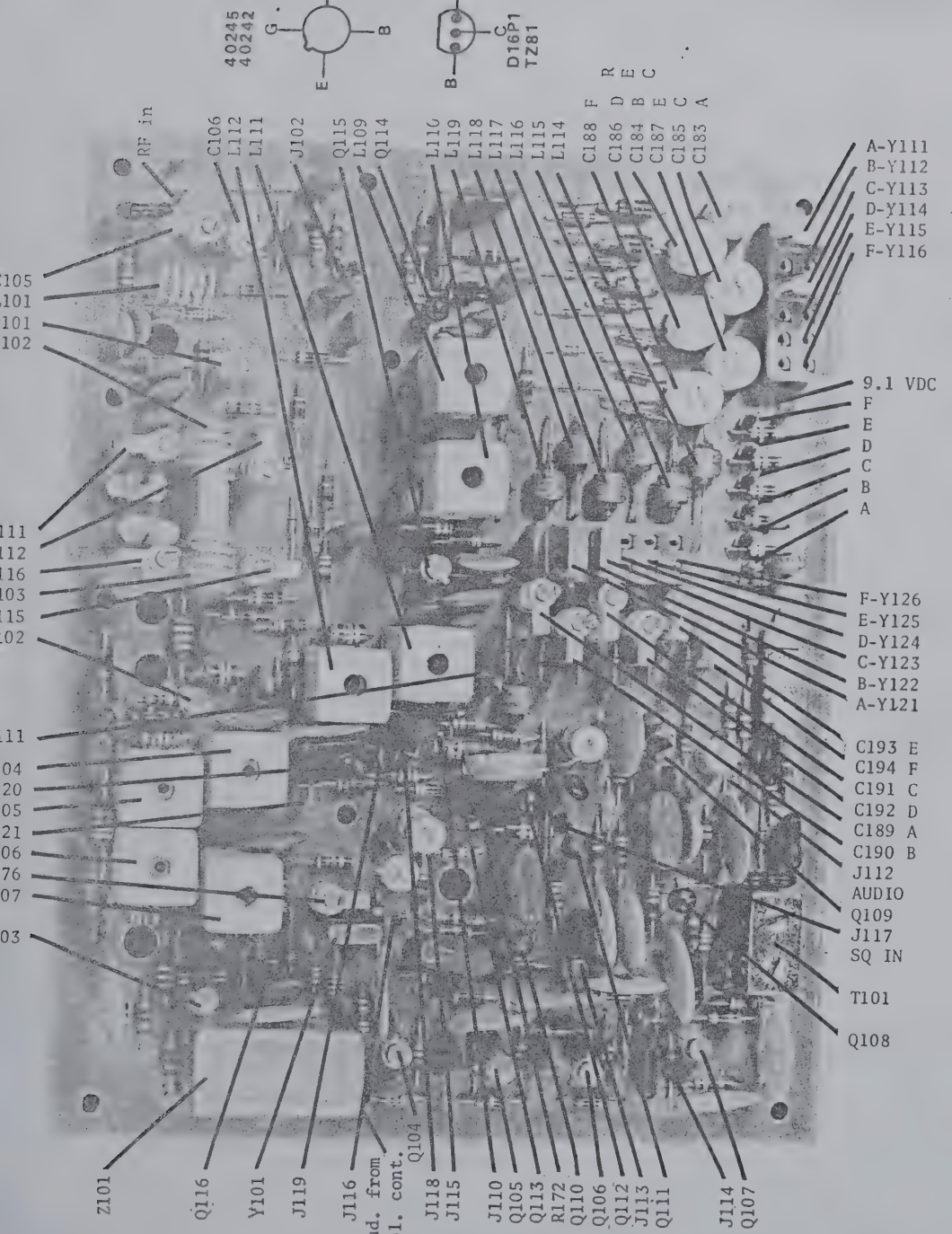


Fig 8-3 Receiver PCB

IX ACCESSORY POWER SUPPLY

9.1 General

When the radio is to be operated from a power source other than 12 volts DC an accessory power supply must be used.

The model 25-34 power supply is designed to convert the ships 24 or 34 volt DC power to the necessary 12 VDC operating power for the radio. The model 25-34 is furnished for 34 volt operation and may be readily converted to 24 volt operation by adding an internal jumper as shown on the power supply schematic.

The model 25-115 power supply is designed to convert the ships 115 volt AC power to the necessary 12 VDC operating power for the radio.

9.2 Installation

The power supplies have no operator controls and may be mounted in any convenient location, although a location close to the radiotelephone is recommended. Access to the fuse, located in one end of the power supply, must be considered when making the installation. The unit can be mounted either vertically (with the fuse and terminal board downward) or horizontally. To mount, remove the base plate and secure it to a solid bulkhead or shelf with suitable hardware. Remount the power supply chassis on the base plate.

9.3 Electrical Connections

Connect the radio to the power supply by connecting the red lead (with in-line fuse) to the +14 VDC terminal on the power supply and the black lead (furnished) from the GROUND post to the -14 VDC terminal.

Connect the AUX P.S. CONTROL terminals of the radio to the SWITCH terminals on the power supply.

Connect the power source to the IN terminals on the power supply, observe polarity when connecting the 24 or 34 volt DC power. USE #14 OR HEAVIER GAUGE WIRE.

NOTE

Connect a heavy gauge ground wire from the GROUND post on the radio to the ships engine and/or ground plate.

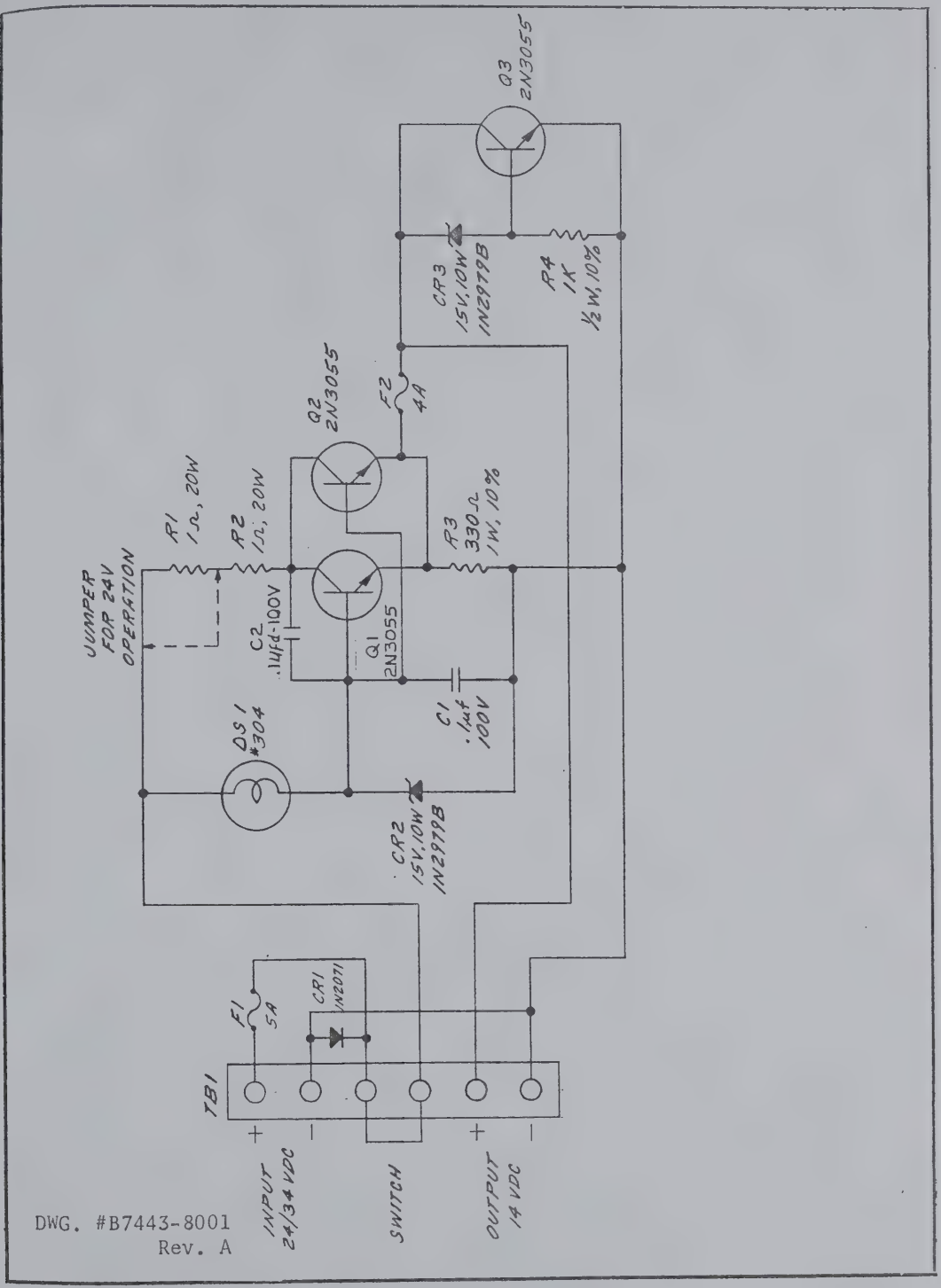


Fig 9-1

Schematic Diagram

25-34 Power Supply

PARTS LIST
25-34 POWER SUPPLY

SYMBOL	PART NUMBER	DESCRIPTION
C1	235-7207P40	Cap., 0.1uf 100V disc
C2	235-7207P40	Cap., 0.1uf 100V disc
CR1	322-7180P1	Diode silicon, 1N2071
CR2	322-7174P15	Diode zener, 1N2979B
CR3	322-7174P15	Diode zener, 1N2979B
DS1	277-7194P1	Lamp, #304
F1	226-1001P8	Fuse, 5 amp., MTH
F2	226-1001P7	Fuse, 4 amp., MTH
Q1	386-7187P2	Transistor, 2N3055
Q2	386-7187P2	Transistor, 2N3055
Q3	386-7187P2	Transistor, 2N3055
R1	280-1107P14	Resistor, 1 ohm, 20 watt WW
R2	280-1107P14	Resistor, 1 ohm, 20 watt WW
R3	280-1180P56	Resistor, 330 ohm, 1 watt, comp.
R4	280-1145P74	Resistor, 1K, 1/2 watt, comp.
TB1	247-7193P106	Terminal block
XC1	7443-1003G1	Cover
XH1	308-7202P1	Heatsink, dual T03
XH2	343-1010P1	Fuseholder post
XH3	343-1011P3	Fuseholder clip
XI1	7443-3301P1	Instruction sheet
XP1	7443-1002P1	Bottom plate
XS1	281-7186P1	Socket, lamp, dual bayonet
XS2	282-7212P1	Socket, transistor T03
XT1	247-1007P3	Terminal strip, 6 pos.
XW1	222-7188P12	Transistor washer, mylar

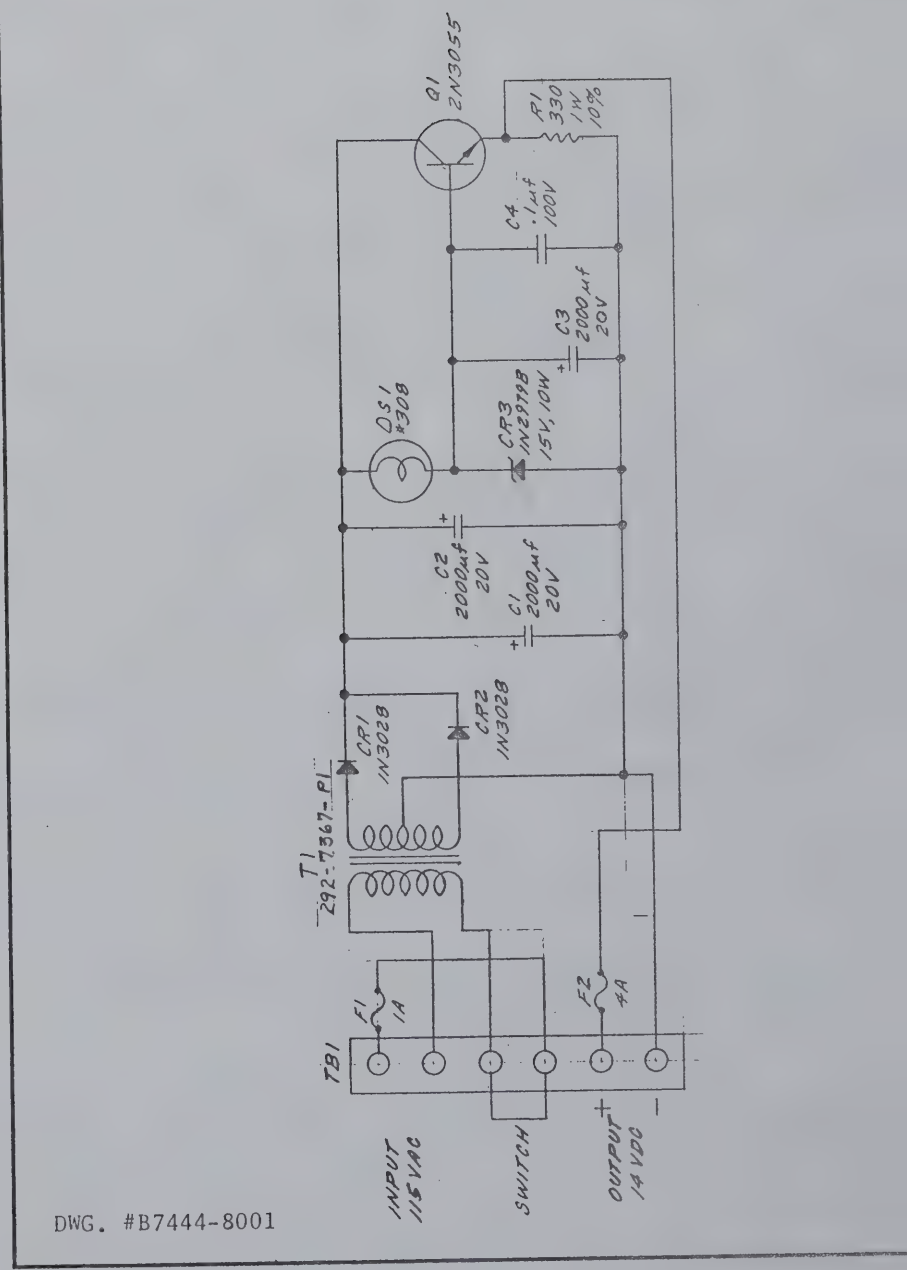


Fig 9-2

Schematic Diagram

25-115 Power Supply

PARTS LIST
25-115 POWER SUPPLY

SYMBOL	PART NUMBER	DESCRIPTION
C1	235-7215P43	Capacitor, 2000uf., 20V., elec.
C2	235-7215P43	Capacitor, 2000uf., 20V., elec.
C3	235-7215P43	Capacitor, 2000uf., 20V., elec.
C4	235-7207P40	Capacitor, 0.1uf., 100V., disc
CR1	322-7181P2	Diode, 1N3208
CR2	322-7181P2	Diode, 1N3208
CR3	322-7174P15	Diode, zener, 1N2979B
DS1	277-7195P1	Lamp #308
F1	226-1001P3	Fuse, 1 amp, AGC
F2	226-1001P7	Fuse, 7 amp, MTH
Q1	386-7187P2	Transistor, 2N3055
R1	280-1180P56	Resistor, 330 ohms, 10%, 1w, comp.
T1	292-7367P1	Transformer, power
TB1	247-7193P106	Terminal block
XC1	7443-1003G1	Cover
XG1	359-1001P1	Grommet 5/16
XH1	343-1010P1	Fuse holder post
XH2	343-1011P3	Fuse holder clip
XI1	7444-3301P1	Instruction sheet
XP1	7443-1002P1	Bottom plate
XS1	281-7186P1	Socket, lamp, dual bayonet
XS2	282-7212P1	Transistor socket T03
XT1	247-1007P3	Terminal strip, 6 pos.
XW1	222-7188P12	Washer, transistor, mylar

WARRANTY

Raytheon warrants all parts of this equipment, except vacuu tubes and transistors, to be free from defects caused by faul materials or poor workmanship, but its liability under said wa ranty is limited to the obligation to repair, or at Raytheon's o tion, to replace without charge, and to return f.o.b. Raytheon plant, any such parts found to be defective under normal use a service within one year from date of shipment to ultimate user, 18 months from date of Raytheon's shipment, whichever peri expires first, provided:

(a) Warranty Registration Card has been filed within thirty da from date of purchase;

(b) Raytheon is promptly notified in writing upon discovery such defects;

(c) The original parts are returned to Raytheon, transportatio charges prepaid; and

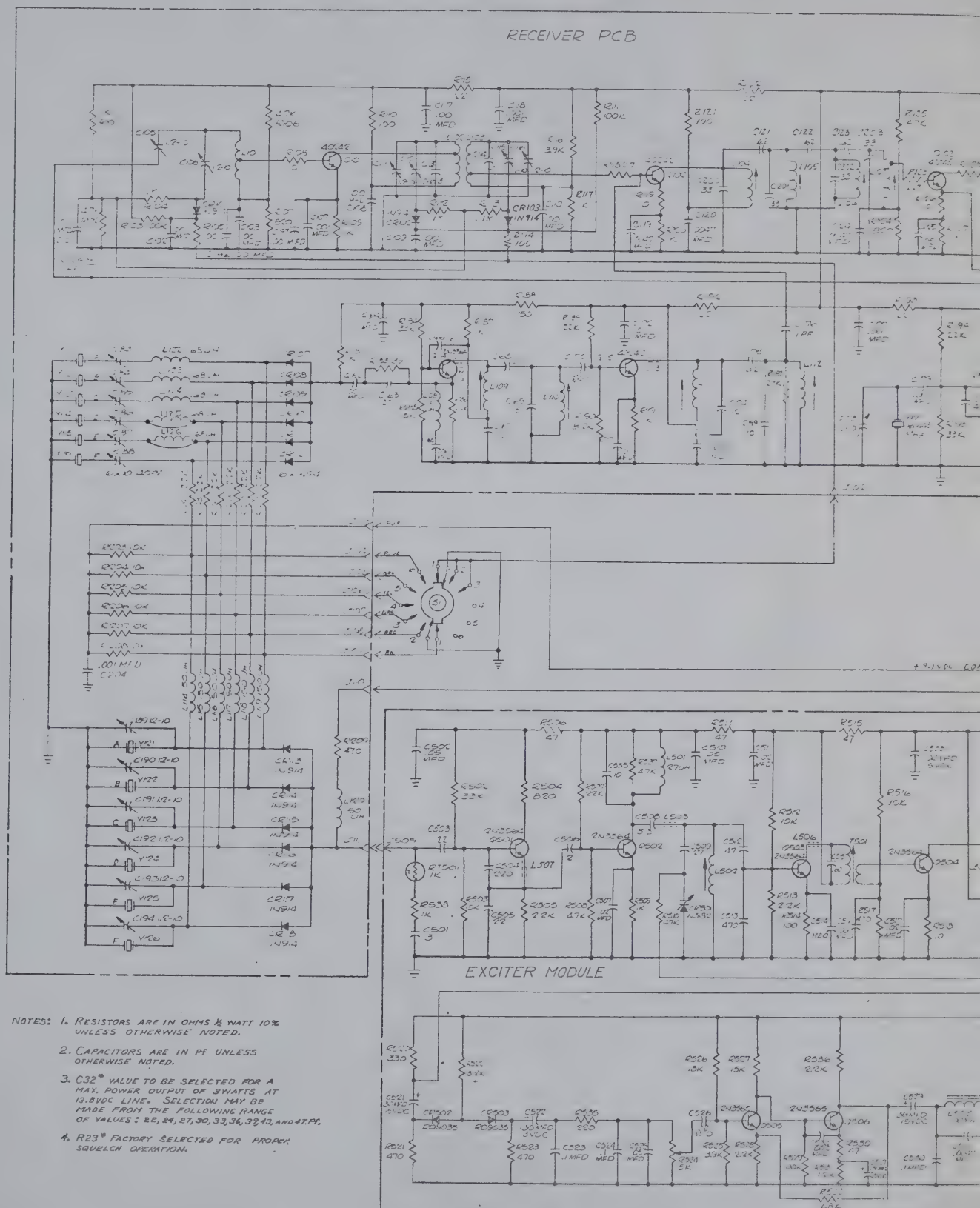
(d) Raytheon's examination shall disclose to its satisfaction tha such defects have not been caused by abuse after delivery.

Raytheon's apparatus or parts thereof which shall have been re paired or altered outside its plant, except by authorized Raytheo service agencies, are not warranted in any respect. The fore going are the only warranties, expressed or implied, made b Raytheon except as to title.

Service Work. Raytheon warrants all service work performe by Raytheon employed engineers to be performed in a good an workmanlike manner, but no other warranty, expressed or im plied, is made by Raytheon with respect to such work.

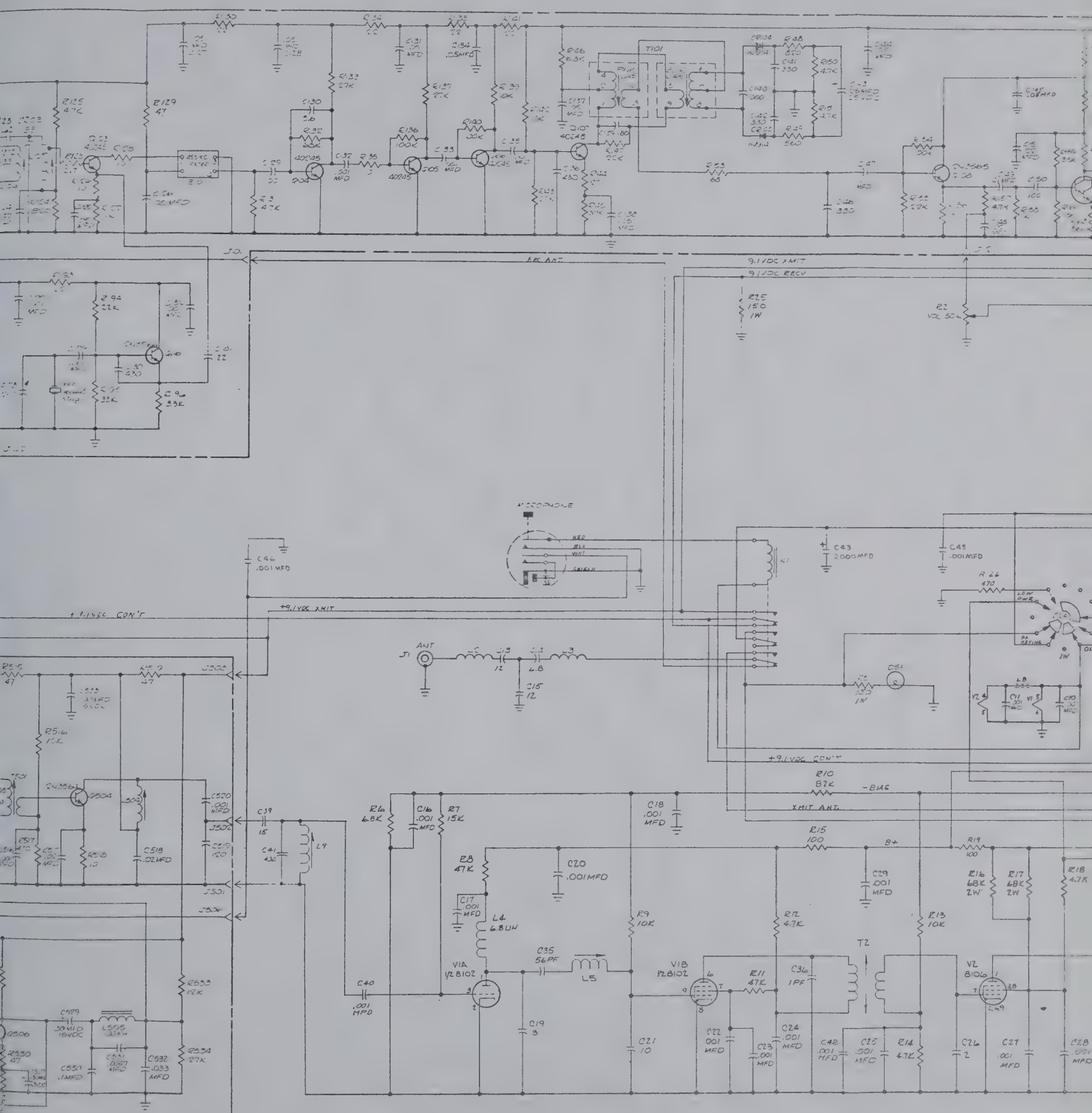
Consequential Damages. Raytheon shall not be liable for specia or consequential damages of any nature with respect to any mer chandise or service sold, rendered, or delivered.

The Raytheon Company reserves the right to make changes o improvements to its products from time to time without incur ring obligation to install same on equipment previously sold.

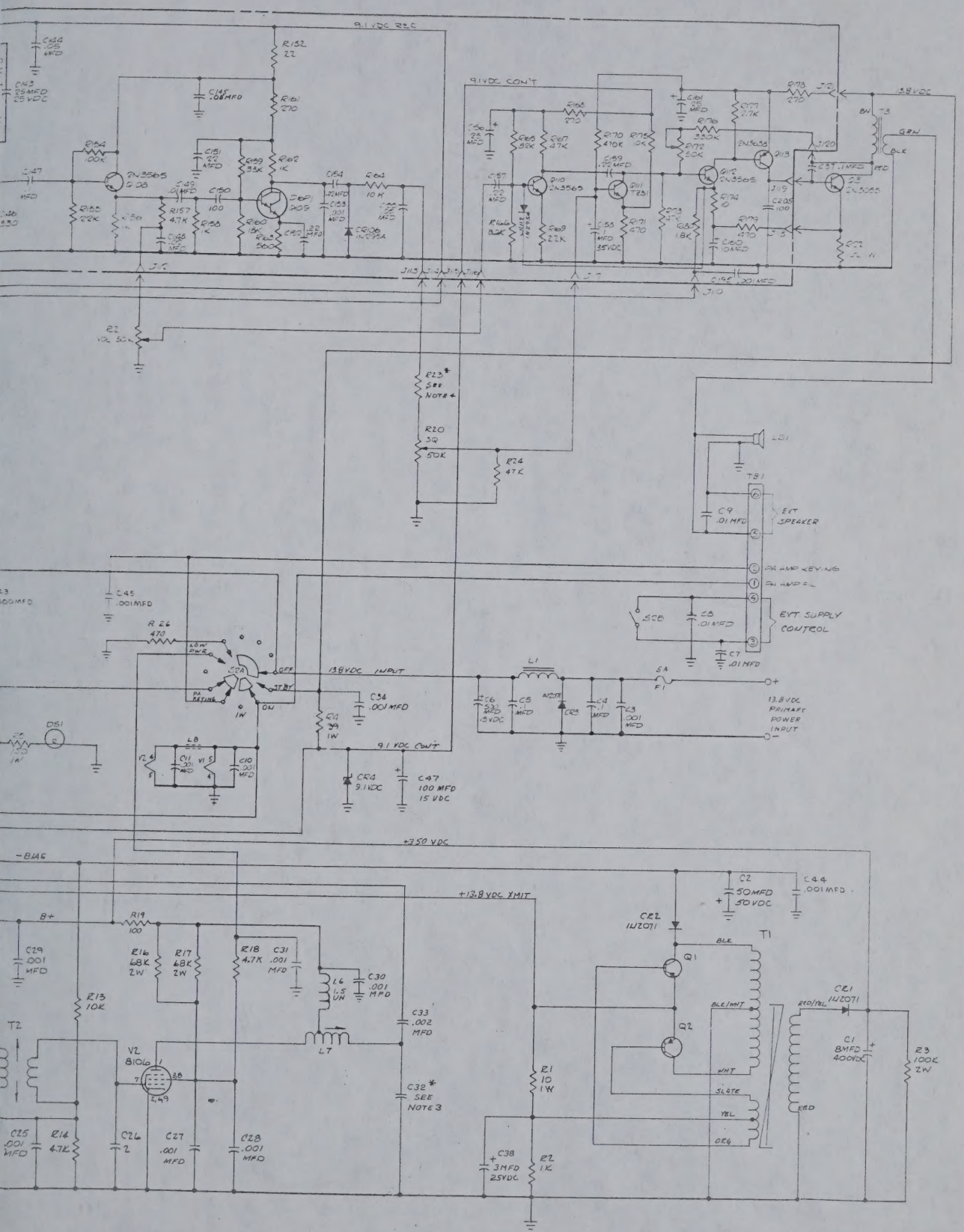


NOTES:
1. RESISTORS ARE IN OHMS ½ WATT 10% UNLESS OTHERWISE NOTED.
2. CAPACITORS ARE IN PF UNLESS OTHERWISE NOTED.
3. C32* VALUE TO BE SELECTED FOR A MAX. POWER OUTPUT OF 3 WATTS AT 13.8VDC LINE. SELECTION MAY BE MADE FROM THE FOLLOWING RANGE OF VALUES: 22, 24, 27, 30, 33, 36, 39, 43, AND 47 PF.
4. R23* FACTORY SELECTED FOR PROPER SQUELCH OPERATION.

RAYTHEON COMPANY
DWG. #E7446-8007 REV. E



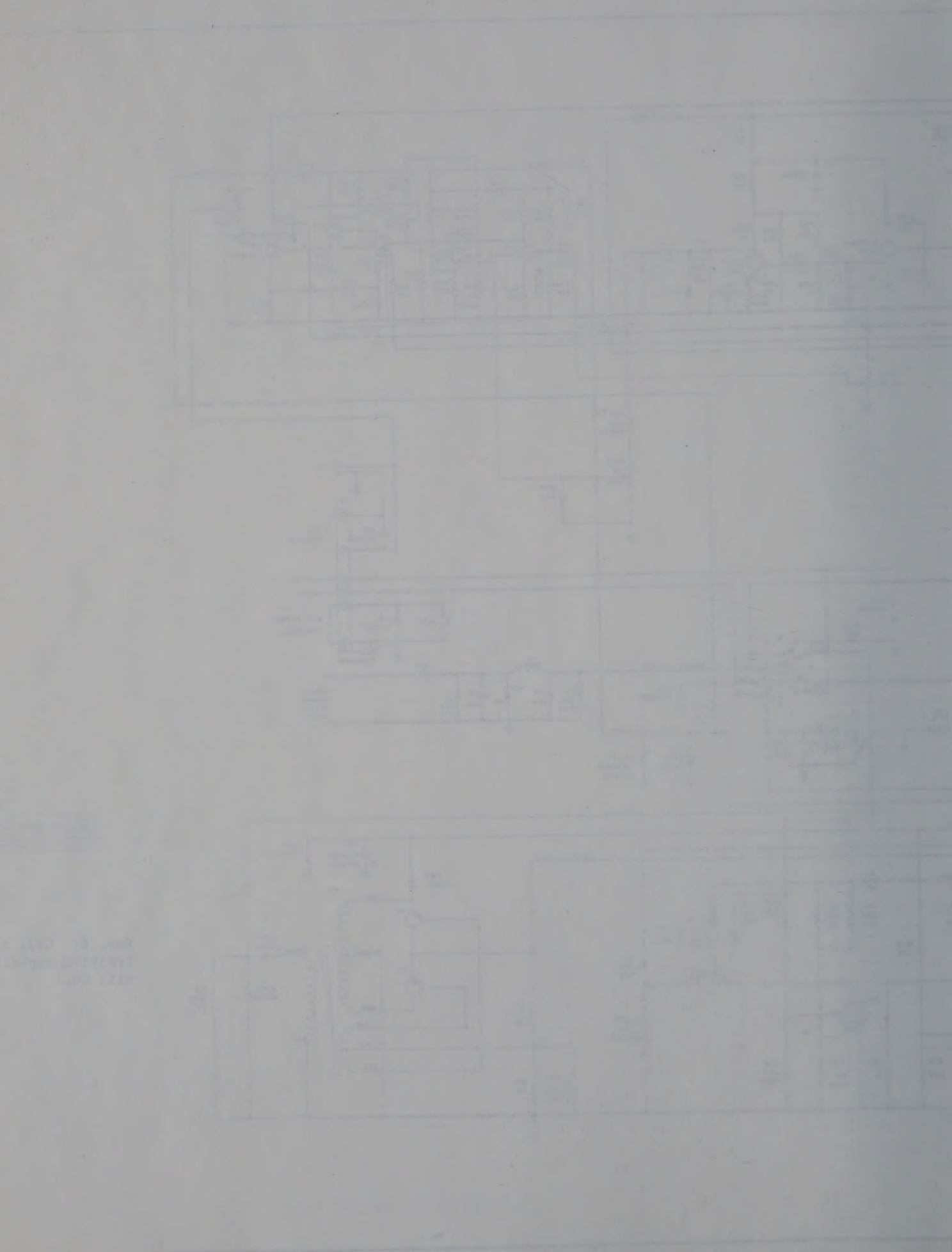
SCHEMATIC DIAGRAM RAY 43

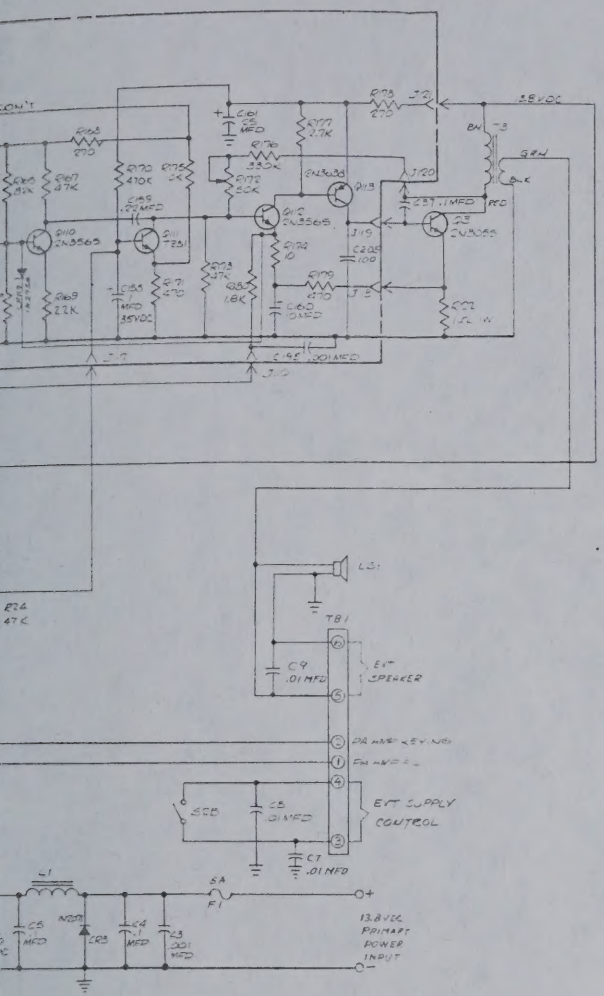


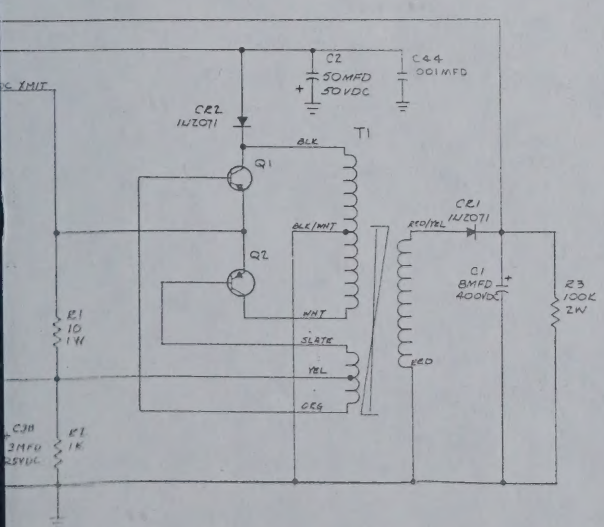
	NUMBER		
	A	C	
CHASSIS	34	47	
RECEIVER EXCITER	534-2001		
EXCITER MODULE	539 535		

NOTE

Rev. B: C43, a 200 trolytic capacitor with C6.







	HIGHEST CIRCUIT SYMBOL USED								
	R	C	L	Q	V	RT	T	CR	Y
CHASSIS	26	47	9	3	2	—	3	4	—
RECEIVER PCB	209	204	26	114	—	—	19	114	24
EXCITER MODULE	534	535	507	526	—	50	50	502	—

NOTE

Rev. B: C43, a 2000uf. 20 volt electrolytic capacitor added in parallel with C6.

PART #IM7446-3302P2